INDOOR AIR QUALITY ASSESSMENT

Lincoln Park Community School at Thurston St
50 Thurston Street
Somerville, MA 02145

Prepared by:
Massachusetts Department of Public Health
Center for Environmental Health
Emergency Response Indoor Air Quality Program

August 2006

Background/Introduction

At the request of Liz Quaratiello, Public Health Nurse at the Somerville Health Department (SHD), the Massachusetts Department of Public Health (MDPH), Center for Environmental Health (CEH) provided assistance and consultation regarding indoor air quality at the Lincoln Park Community School (LPCS) at 50 Thurston Street (Thurston St. School), Somerville, Massachusetts. The assessment was prompted by occupant concerns of reoccurring eye irritations. On March 1, 2006, Sharon Lee, an Environmental Analyst in CEH's Emergency Response/Indoor Air Quality (ER/IAQ) Program, conducted an assessment at the Thurston St. School. During the assessment, Ms. Lee was accompanied by Ms. Quaratiello.

The Thurston St. School occupies all but two rooms in what was formerly the former St. Ann's School, which is owned by the Archdiocese of Boston. Staff and kindergarten through fourth grade students were relocated to this building in August, 2005. The original LPCS was demolished for construction of a new school. Students and staff are scheduled to remain at this location until summer 2007. The school is a two-story, red brick building constructed in 1917. A two-story addition was made to the building during the 1950s. Circa 2003, the 1950s addition experienced fire damage. The majority of damage was sustained by a first floor classroom (room 122), while the second floor experienced minor damage. At the time of assessment, the first floor classroom was renovated and mechanical ventilation components replaced. Windows are openable throughout the building.

Methods

Air tests for carbon monoxide, carbon dioxide, temperature and relative humidity were taken with the TSI, Q-Trak, IAQ Monitor, Model 8551. Air tests for airborne particulate matter with a diameter less than 2.5 micrometers were taken with the TSI, DUSTTRAK™ Aerosol Monitor Model 8520. Screening for total volatile organic compounds (TVOCs) was conducted using a Thermo Environmental Instruments Inc., Model 580 Series Photo Ionization Detector (PID). CEH staff also performed a visual inspection of building materials for water damage and/or microbial growth.

Results

The Thurston St. School houses approximately 200 kindergarten through fourth grade students and a staff of approximately 25. Tests were taken under normal operating conditions. Test results appear in Table 1.

Discussion

Ventilation

It can be seen from Table 1 that carbon dioxide levels were above 800 parts per million (ppm) in all but two areas surveyed, indicating inadequate air exchange in most areas of the school. The 1917 portion of the building has no mechanical ventilation system, but relies solely on openable windows for air exchange. It appears that exhaust ventilation was originally provided to classrooms via gravity exhaust vents; however, this system has been abandoned. Ductwork within the building once allowed air to be drawn from classrooms via a “cubby” opening in the wall (Picture 1). Airflow within the duct is regulated by a louver with an attached pull-chain. In one room, the wall opening was sealed. If the system is not in use, consideration should be given to sealing all exhaust vents to prevent backdrafting and movement of materials into occupied areas. Without sufficient supply and exhaust ventilation, normally occurring environmental pollutants can build up and lead to air quality/comfort complaints.

Unit ventilator (univent) systems provide mechanical ventilation to classrooms in the 1950s addition (Pictures 2 and 3). A univent draws air from outdoors through a fresh air intake located on the exterior wall of the building (Picture 4) and returns air through an air intake located at the base of the unit (Figure 1). Fresh and return air are mixed, filtered, heated and/or cooled and provided to classrooms through a diffuser located on the top of the unit. Mechanical exhaust ventilation in these classrooms is provided by exhaust vents located in closets (Picture 5). These vents are ducted to a rooftop exhaust fan (Picture 6). At the time of the assessment, classroom univents and exhaust systems were deactivated in all areas, therefore no means of mechanical ventilation were being provided.

To maximize air exchange, the MDPH recommends that both supply and exhaust ventilation operate continuously during periods of school occupancy. In order to have proper ventilation with a univent and exhaust system, the systems must be balanced to provide an adequate amount of fresh air to the interior of a room while removing stale air from the room. It is recommended that existing ventilation systems be re-balanced every five years to ensure adequate air systems function (SMACNA, 1994). The date of the last balancing of these systems was not available at the time of the assessment.

The Massachusetts Building Code requires that each room have a minimum ventilation rate of 15 cubic feet per minute (cfm) per occupant of fresh outside air or openable windows (SBBRS, 1997; BOCA, 1993). The ventilation must be on at all times that the room is occupied. Providing adequate fresh air ventilation with open windows and maintaining the temperature in the comfort range during the cold weather season is impractical. Mechanical ventilation is usually required to provide adequate fresh air ventilation.

Carbon dioxide is not a problem in and of itself. It is used as an indicator of the adequacy of the fresh air ventilation. As carbon dioxide levels rise, it indicates that the ventilating system is malfunctioning or the design occupancy of the room is being exceeded. When this happens a buildup of common indoor air pollutants can occur, leading to discomfort or health complaints. The Occupational Safety and Health Administration (OSHA) standard for carbon dioxide is 5,000 parts per million parts of air (ppm). Workers may be exposed to this level for 40 hours/week, based on a time-weighted average (OSHA, 1997).

The MDPH uses a guideline of 800 ppm for publicly occupied buildings. A guideline of 600 ppm or less is preferred in schools due to the fact that the majority of occupants are young and considered to be a more sensitive population in the evaluation of environmental health status. Inadequate ventilation and/or elevated temperatures are major causes of complaints such as respiratory, eye, nose and throat irritation, lethargy and headaches. For more information on carbon dioxide see Appendix A.

Temperature readings ranged from 66^{o} F to 75^{o} F in classroom/office areas and 59^{o} F in the gym. These readings were below the MDPH comfort guidelines in some areas surveyed. The MDPH recommends that indoor air temperatures be maintained in a range of 70^{o} F to 78^{o} F in order to provide for the comfort of building occupants. Building occupants reported temperature control issues. CEH staff observed a number of rooms where items were blocking radiators (Picture 7), thereby preventing movement of heat into classrooms. In many cases concerning indoor air quality, fluctuations of temperature in occupied spaces are typically experienced, even in a building with an adequate fresh air supply. In addition, it is difficult to control temperature and maintain comfort without an operating mechanical ventilation system.

The relative humidity measurements in the Thurston St. School ranged from 11 to 26 percent, which were below the MDPH recommended comfort range of 40 to 60 percent for indoor air relative humidity. Relative humidity levels in the building would be expected to drop during the winter months due to heating. The sensation of dryness and irritation is common in a low relative humidity environment. Low relative humidity is a very common problem during the heating season in the northeast part of the United States.

Microbial/Moisture Concerns

According to staff, the school experienced a steam leak in the basement storage area in early 2006 (Picture 8). The storage area was constructed prior to the LPCS population moving into the school. The structure consists of wooden supports and gypsum wallboard (GW) walls. As a result of the leak, walls and other materials in the storage room were damaged. At the time of the assessment, CEH staff observed mold growth on the GW (Picture 9), as well as on the wooden support beams and the door (Picture 10). CEH staff recommended immediate removal and replacement of damaged material (i.e., GW, wooden supports and the door) in accordance with US EPA guidelines. CEH staff also recommended that non-porous physical education equipment (i.e., mats) be cleaned with an appropriate antimicrobial.

A few areas had water-stained ceiling plaster and water-damaged ceiling tiles (Pictures 11 and 12), which can indicate leaks from the roof or plumbing system. Plaster is not a medium for mold growth; however, dust on the surface and between paint layers can provide conditions for growth. Unlike plaster, water-damaged ceiling tiles can serve as a medium for mold and should be replaced after a water leak is discovered and repaired.

A water-damaged wooden window frame was observed in one classroom (Picture 13). Exposed fibrous insulation material was observed in this window frame. Fiberglass/insulation can be a source of skin, eye and respiratory irritation. If wetted repeatedly, these materials can also allow for mold growth.

The US Environmental Protection Agency (US EPA) and the American Conference of Governmental Industrial Hygienists (ACGIH) recommends that porous materials be dried with fans and heating within 24 to 48 hours of becoming wet (US EPA, 2001; ACGIH, 1989). If porous materials are not dried within this time frame, mold growth may occur. Water-damaged porous materials cannot be adequately cleaned to remove mold growth. The application of a mildewcide to moldy porous materials is not recommended.

A number of breaches were observed around the exterior of the building. CEH staff observed damaged aluminum siding and window casing (Pictures 4 and 14). Damage to brickwork, missing/damaged mortar, as well as a broken window were also observed along the building exterior (Pictures 15 to 17). Breaches in the building envelope can provide a means of water penetration and may also provide a means of egress for pests/rodents into the building.

Plants were located in several classrooms (Picture 18). Plants can be a source of pollen and mold, which can be respiratory irritants for some individuals. Plants should be properly maintained and equipped with drip pans to prevent moistening and potential mold growth to porous building materials.

Lastly, stagnant water was observed in the catch basin of a water cooler (Picture 19). Stagnant water can be a source of odors, and materials (i.e., dust) collected in the water can provide a medium for mold growth. Water basins should be emptied and cleaned periodically to prevent growth and odors.

Other IAQ Evaluations

Indoor air quality can be negatively influenced by the presence of respiratory irritants, such as products of combustion. The process of combustion produces a number of pollutants. Common combustion emissions include carbon monoxide, carbon dioxide, water vapor and smoke (fine airborne particle material). Of these materials, exposure to carbon monoxide and particulate matter with a diameter of 2.5 micrometers (μm) or less (PM2.5) can produce immediate, acute health effects upon exposure. To determine whether combustion products were present in the school environment, MDPH staff obtained measurements for carbon monoxide and PM2.5.

Carbon monoxide is a by-product of incomplete combustion of organic matter (e.g., gasoline, wood and tobacco). Exposure to carbon monoxide can produce immediate and acute health affects. Several air quality standards have been established to address carbon monoxide and prevent symptoms from exposure to these substances. The MDPH established a corrective action level concerning carbon monoxide in ice skating rinks that use fossil-fueled ice resurfacing equipment. If an operator of an indoor ice rink measures a carbon monoxide level over 30 ppm, taken 20 minutes after resurfacing within a rink, that operator must take actions to reduce carbon monoxide levels (MDPH, 1997).

The American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE) has adopted the National Ambient Air Quality Standards (NAAQS) as one set of criteria for assessing indoor air quality and monitoring of fresh air introduced by HVAC systems (ASHRAE, 1989). The NAAQS are standards established by the US EPA to protect the public health from six criteria pollutants, including carbon monoxide and particulate matter (US EPA, 2000a). As recommended by ASHRAE, pollutant levels of fresh air introduced to a building should not exceed the NAAQS levels (ASHRAE, 1989). The NAAQS were adopted by reference in the Building Officials & Code Administrators (BOCA) National Mechanical Code of 1993 (BOCA, 1993), which is now an HVAC standard included in the Massachusetts State Building Code (SBBRS, 1997). According to the NAAQS, carbon monoxide levels in outdoor air should not exceed 9 ppm in an eight-hour average (US EPA, 2000a).

Carbon monoxide should not be present in a typical, indoor environment. If it *is* present, indoor carbon monoxide levels should be less than or equal to outdoor levels. On the day of the assessment a slight outdoor carbon monoxide concentration of 1 ppm was measured (Table 1). Carbon monoxide levels measured in the school were non-detect (ND) (Table 1).

The US EPA has established NAAQS limits for exposure to particulate matter. Particulate matter is airborne solids that can be irritating to the eyes, nose and throat. The NAAQS originally established exposure limits to particulate matter with a diameter of 10 μm or less (PM10). According to the NAAQS, PM10 levels should not exceed 150 microgram per cubic meter ($\mu g/m^3$) in a 24-hour average (US EPA, 2000a). These standards were adopted by both ASHRAE and BOCA. Since the issuance of the ASHRAE standard and BOCA Code, US

EPA proposed a more protective standard for fine airborne particles. This more stringent PM2.5 standard requires outdoor air particle levels be maintained below 65 μg/m^3 over a 24-hour average (US EPA, 2000a). Although both the ASHRAE standard and BOCA Code adopted the PM10 standard for evaluating air quality, MDPH uses the more protective PM2.5 standard for evaluating airborne particulate matter concentrations in the indoor environment.

Outdoor PM2.5 concentrations were measured at 11 μg/m^3 (Table 1). PM2.5 levels measured indoors ranged from 1 to 9 μg/m^3 (Table 1), which were below the NAAQS of 65 μg/m^3. Frequently, indoor air levels of particulates (including PM2.5) can be at higher levels than those measured outdoors. A number of mechanical devices and/or activities that occur in schools can generate particulate during normal operations. Sources of indoor airborne particulates may include but are not limited to particles generated during cooking in the cafeteria stoves and microwave ovens; use of photocopiers, fax machines and computer printing devices; operation of an ordinary vacuum cleaner and heavy foot traffic indoors.

Indoor air quality can also be negatively influenced by the presence of materials containing volatile organic compounds (VOCs). VOCs are carbon-containing substances that have the ability to evaporate at room temperature. Exposure to low levels of total VOCs (TVOCs) may produce eye, nose, throat and/or respiratory irritation in some sensitive individuals. For example, chemicals evaporating from a paint can stored at room temperature would most likely contain VOCs. In an effort to determine whether VOCs were present in the building, air monitoring for TVOCs was conducted. An outdoor air sample was taken for comparison. Outdoor TVOC concentrations were ND (Table 1). Indoor TVOC concentrations were ND in all but one area (Table 1).

A TVOC level of 2 ppm was measured in room 211. When CEH staff initially entered the room, a slight cleaning agent odor was detected; however, no TVOC levels were measured. While CEH staff was observing conditions near the window, the occupant began cleaning a nearby desk with an all purpose cleaner. Immediately following use of the product, the PID measured TVOC levels between 1-2 ppm. The brand of cleaner used does not contain ingredients typical of cleaning agents (i.e., chlorine, phosphates), but instead consists of "active ingredients derived from coconut and palm oils" (Method, 2006). According to the Material Safety Data Sheet (MSDS) for this product, contact with the all purpose cleaner can cause irritation to eyes and skin. CEH staff also observed a bottle of multi-purpose cleaner/disinfectant in room 211. According to the MSDS for this product, eye contact can result in irritation and stinging; skin contact may cause mild to moderate irritation (Spray Nine, 2002). It is important to note that the aforementioned reoccurring eye irritation problems were experienced in this room. According to room occupants, this area is cleaned frequently. The frequent use of cleaning agents in room 211 coupled with the lack of adequate ventilation (i.e. carbon dioxide level was 1279 ppm) is probably responsible for the repeated eye irritations experienced by occupants in this room.

Please note, TVOC air measurements are only reflective of the indoor air concentrations present at the time of sampling. As previously described, indoor air concentrations can be greatly impacted by the use of TVOC containing products. In an effort to identify other materials that can potentially increase indoor TVOC concentrations, MDPH staff examined classrooms for products containing these respiratory irritants. Several classrooms contained dry erase boards and dry erase board markers, which may contain VOCs, such as methyl isobutyl ketone, n-butyl acetate and butyl-cellusolve (Sanford, 1999).

Several other conditions that can affect indoor air quality were observed during the assessment. Accumulated chalk dust was noted in some classrooms (Picture 20). Chalk dust is a fine particulate, which can be easily aerosolized and is an eye and respiratory irritant. Similarly, pencil shavings were observed accumulated at the base of pencil sharpeners and other surfaces. Pencil shavings can become airborne, providing a source for eye and respiratory irritation.

Missing ceiling tiles (Picture 21) and items hanging from ceiling tiles were seen in a few areas. Missing or movement of ceiling tiles can result in the movement of dust, dirt, odors and other pollutants to occupied areas. Dust can be irritating to the eyes, nose and respiratory system.

Also of note was the amount of materials stored in some classrooms. Items were observed on windowsills, tabletops, counters, bookcases and desks. The large number of items stored in classrooms provides a source for dusts to accumulate. These items (e.g., papers, folders, boxes) make it difficult for custodial staff to clean. Items should be relocated and/or be cleaned periodically to avoid excessive dust build up.

Damaged or missing floor tiles were observed in some areas (Pictures 22). These floor tiles may contain asbestos. Intact asbestos-containing materials do not pose a health hazard. If damaged, asbestos-containing materials can be rendered friable and become aerosolized. Friable asbestos is a chronic (long-term) health hazard, but will not produce acute (short-term) health effects (e.g., headaches) typically associated with buildings believed to have indoor air quality problems. Where asbestos-containing materials are found damaged, these materials should be removed or remediated in a manner consistent with Massachusetts asbestos remediation laws (MDLI, 1993).

Lastly, in an effort to reduce noise from sliding chairs, tennis balls had been sliced open and placed on chair legs (Picture 23). Tennis balls are made of a number of materials that are a source of respiratory irritants. Constant wearing of tennis balls can produce fibers and off gas VOCs. Tennis balls are made with a natural rubber latex bladder, which becomes abraded when used as a chair leg pad. Use of tennis balls in this manner may introduce latex dust into the school environment. Some individuals are highly allergic to latex (e.g., spina bifida patients) (SBAA, 2001). It is recommended that the use of materials containing latex be limited in buildings to reduce the likelihood of symptoms in sensitive individuals (NIOSH, 1997). A question and answer sheet concerning latex allergy is attached as Appendix B (NIOSH, 1998b).

Conclusions/Recommendations

A number of indoor air quality-related concerns were observed at the time of the assessment. In view of the findings at the time of this visit, the following recommendations are made to improve general indoor air quality:

1. Operate both supply and exhaust ventilation continuously, independent of classroom thermostat control, during periods of school occupancy to maximize air exchange.
2. Use openable windows to facilitate air exchange. Care should be taken to ensure windows are properly closed at night and weekends to avoid water penetration or freezing of pipes and potential flooding.
3. Refrain from using cleaning agents that can cause eye, skin or respiratory irritation. Consider cleaning with a mild detergent or soap and water solution.
4. Examine each univent for function. Survey classrooms for univent function to ascertain if an adequate air supply exists for each room. Operate univents while classrooms are

occupied. Check fresh air intakes for repair and increase the percentage of fresh air intake if necessary.

5. Remove all blockages from univents and exhaust vents to ensure adequate airflow. Clean univent and exhaust vents periodically to prevent excessive dust build-up.
6. If not in use, consideration should be given to sealing all gravity exhaust vents to prevent backdrafting and movement of materials into occupied areas.
7. Consult a ventilation engineer concerning balancing of the mechanical ventilation systems. Ventilation industrial standards recommend that mechanical ventilation systems be balanced every five years (SMACNA, 1994).
8. Remove blockages to radiators to allow even warming of classrooms and to prevent fire hazards.
9. For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, scrupulous cleaning practices should be adopted to minimize common indoor air contaminants whose irritant effects can be enhanced when the relative humidity is low. To control for dusts, a high efficiency particulate arrestance (HEPA) filter equipped vacuum cleaner in conjunction with wet wiping of all surfaces is recommended. Avoid the use of feather dusters. Drinking water during the day can help ease some symptoms associated with a dry environment (throat and sinus irritations).
10. Remove and discard all mold contaminated building materials (i.e. walls, doors) in the basement storage area in accordance to guidelines outlined in “Mold Remediation in Schools and Commercial Buildings” published by the US Environmental Protection Agency (US EPA, 2001). This document can be downloaded from the US EPA website

at: http://www.epa.gov/iaq/molds/mold_remediation.html. Disinfect all non-porous equipment with an appropriate antimicrobial agent.

11. Ensure roof and/or plumbing leaks are repaired, and replace/repair water damaged building materials. Examine the area above and around these areas for mold growth. Disinfect areas of water leaks with an appropriate antimicrobial.
12. Repair window frames to prevent drafts and water penetration.
13. Repoint the building exterior to prevent water penetration.
14. Ensure all utility holes and breaches are properly sealed to prevent water or pest penetration.
15. Refrain from using different chemical agents *together* to prevent chemical interaction and potential production of irritating or hazardous materials.
16. Empty standing water from planters and/or move away from univent fresh air intakes.
17. Remediate damaged floor tiles in conformance with Massachusetts asbestos remediation and hazardous waste disposal laws.
18. Relocate or consider reducing the amount of materials stored in classrooms to allow for more thorough cleaning. Clean items regularly with a wet cloth or sponge to prevent excessive dust build-up.
19. Clean chalkboard/dry erase marker trays and pencil sharpeners regularly to prevent the build-up of excessive chalk dust and particulates.
20. Replace missing ceiling tiles and refrain from hanging objects from the ceiling tile system to prevent the egress of drafts, odors and particulate matter into occupied areas.
21. Consider replacing tennis balls with felt bottomed alternative “glides” (Picture 24).

22. Consider adopting the US EPA (2000b) document, "Tools for Schools", to maintain a good indoor air quality environment in the building. This document can be downloaded from the Internet at http://www.epa.gov/iaq/schools/index.html.

23. Refer to resource manuals and other related indoor air quality documents for further building-wide evaluations and advice on maintaining public buildings. Copies of these materials are located on the MDPH's website: http://mass.gov/dph/indoor_air

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Picture 1

Exhaust vent cubby with materials stored in cut out area

Picture 2

1950s univent

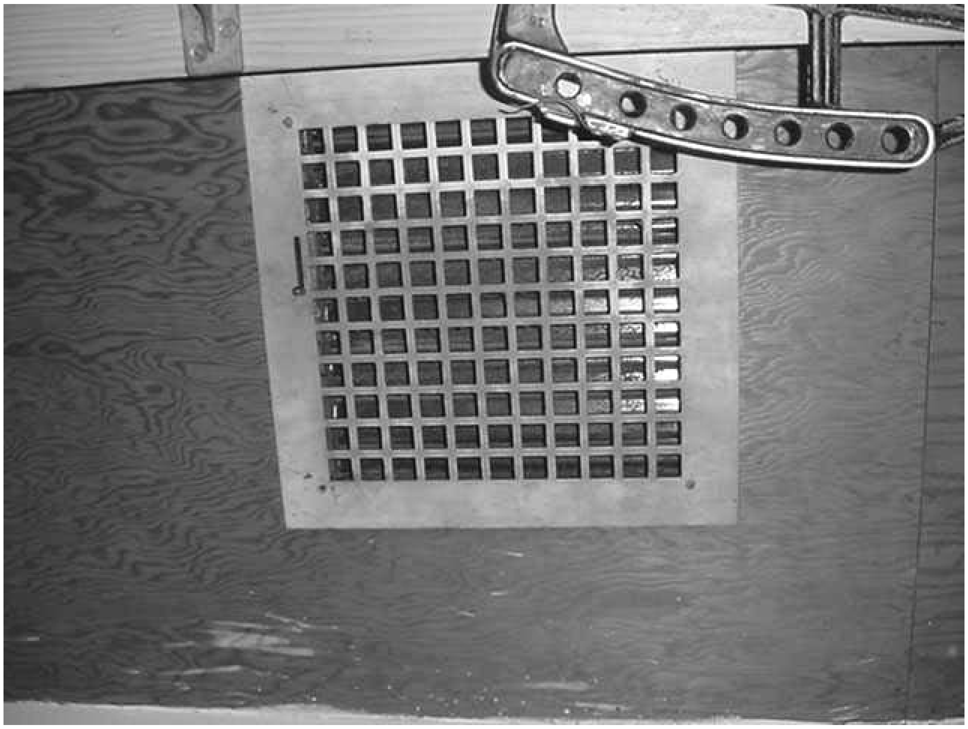
Picture 3

univent retrofitted after fire

Picture 4

Univent fresh air intake

Picture 5



Closet exhaust vent

Picture 6

Rooftop mounted exhaust fan

Picture 7

Materials placed in front of radiators

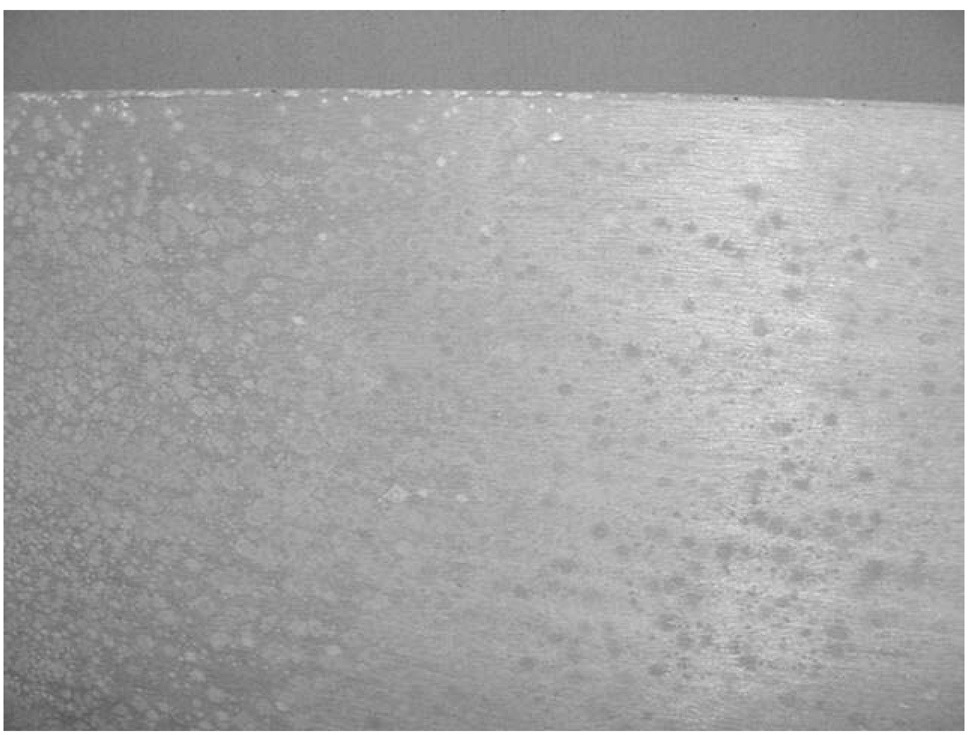
Picture 8

Steam leak causing damage in storage room

Picture 9

Mold growth on gypsum wallboard and wood supports

Picture 10



Mold growth on storage room door

Picture 11

Water-damaged ceiling plaster

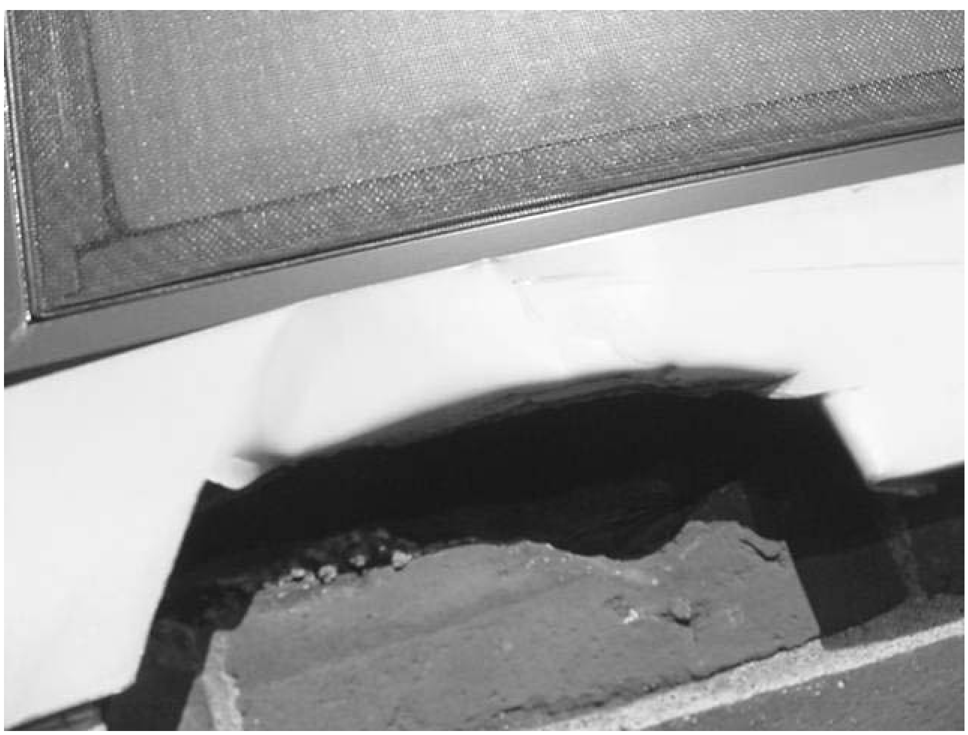
Picture 12

Water-damaged ceiling tile

Picture 13

Water-damaged window frame with exposed insulation

Picture 14

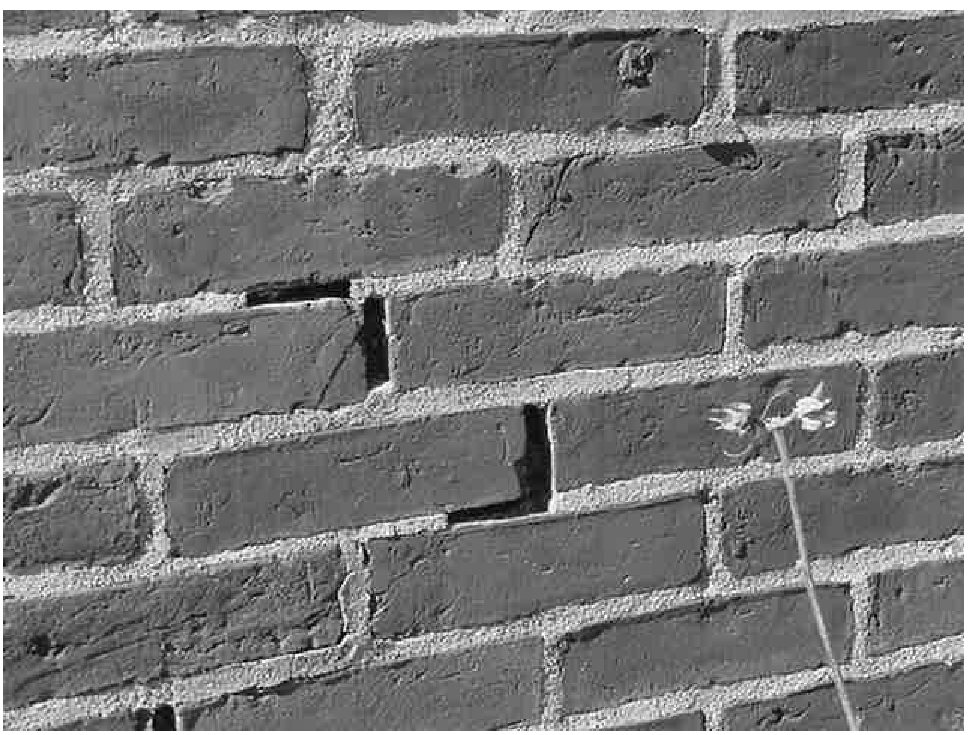


Damaged metal window siding

Picture 15

Breaches to the window frame

Picture 16



Missing mortar

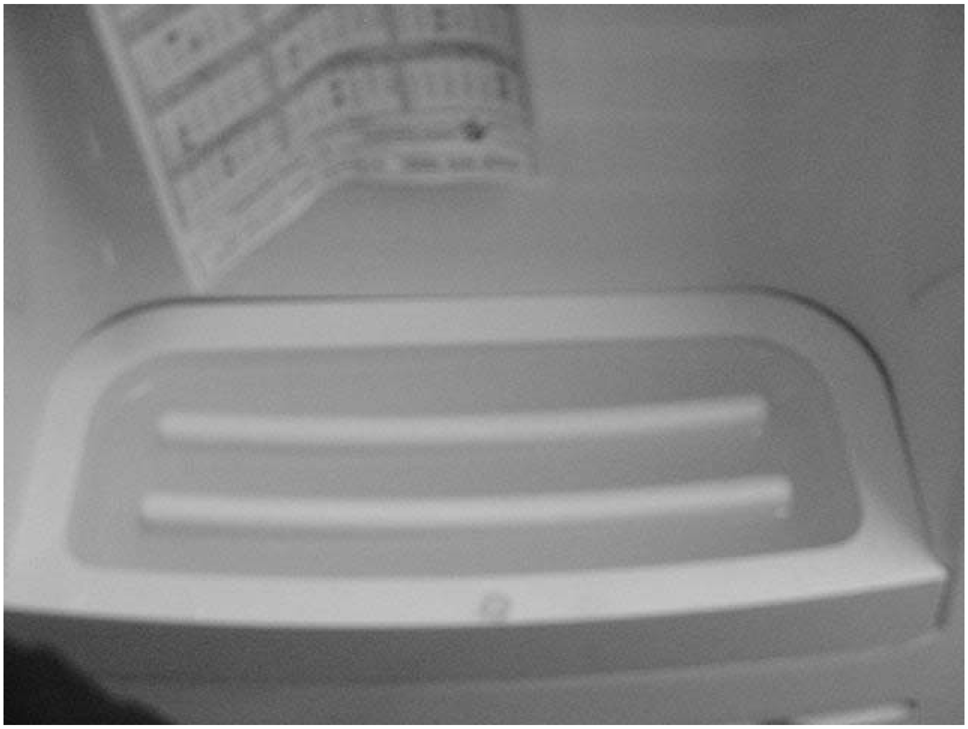
Picture 17

Broken window

Picture 18

Plants

Picture 19



Standing water in catch basin

Picture 20

Accumulated chalk dust

Picture 21

Missing ceiling tile, note string suspending item

Picture 22

Missing floor tile

Picture 23

Tennis balls on chair legs

Picture 24

Alternative"glides" that can be used in place of tennis balls on chair legs

Lincoln Park Community School at Thurston St **Indoor Air Results**

50 Thurston Street, Somerville, MA 02145 **Date: 3/1/2006**

Table 1

Location/ Room	Occupants in Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	TVOCs (ppm)	PM2.5 (µg/m3)	Windows Openable	Ventilation		Remarks
									Supply	Exhaust	
background		40	5	445	1	ND	11	N			
basement storage											WD-WP, WD-CP, WD-GW, WD-porous material, GW-mold, porous material-mold, steam leak.
gym	8	59	26	676	ND	ND	7	Y # open: 0 # total: 10	N	N	Hallway DO,
OT	0	72	20	1283	ND	ND	4	Y # open: 0 # total: 1	N	N	
109A	12	71	15	1246	ND	ND	5	Y # open: 0 # total: 4	N	N	Hallway DO, DEM, cleaners, small heater.
109B	7	72	18	1186	ND	ND	4	Y # open: 0 # total: 4	N	N	CD, DEM, PS, items, items hanging from CT.

ppm = parts per million
µg/m3 = micrograms per cubic meter

AD = air deodorizer
AP = air purifier
aqua. = aquarium

AT = ajar ceiling tile
BD = backdraft
CD = chalk dust
CP = ceiling plaster
CT = ceiling tile
DEM = dry erase materials

design = proximity to door
FC = food container
G = gravity
GW = gypsum wallboard
M = mechanical
MT = missing ceiling tile

NC = non-carpeted
ND = non detect
PC = photocopier
PF = personal fan
plug-in = plug-in air freshener
PS = pencil shavings

sci. chem. = science chemicals
TB = tennis balls
terra. = terrarium
UF = upholstered furniture
VL = vent location
WP = wall plaster

Comfort Guidelines

Carbon Dioxide: < 600 ppm = preferred
600 - 800 ppm = acceptable
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

Lincoln Park Community School at Thurston St

50 Thurston Street, Somerville, MA 02145

Indoor Air Results

Date: 3/1/2006

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Location/ Room	Occupants in Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	TVOCs (ppm)	PM2.5 (µg/m3)	Windows Openable	Ventilation Supply	Ventilation Exhaust	Remarks
110A	1	71	17	1086	ND	ND	3	Y # open: 0 # total: 4	N	N	Hallway DO, #MT/AT: 1.
110B	11	72	18	1070	ND	ND	2	Y # open: 0 # total: 3	N	N	AD, DEM, cleaners.
114	12	71	22	1180	ND	ND	8	Y # open: 0 # total: 5	N	N	Hallway DO, DEM, items, plants.
116	10	66	26	1114	ND	ND	5	Y # open: 0 # total: 5	N	N	Hallway DO, DEM, PS, items, items hanging from CT.
122	1	72	11	666	ND	ND	8	Y # open: 0 # total: 6	Y univent (off)	Y closet (off)	breach sink/counter, CD.
201	17	74	16	1351	ND	ND	7	Y # open: 4 # total: 10	N	N	CD, DEM, items, plants, heaters blocked.
203	22	74	18	1329	ND	ND	4	Y # open: 0 # total: 10	N	N	DEM, items, plants, excessive items.

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µg/m3 = micrograms per cubic meter

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plug-in = plug-in air freshener
PS = pencil shavings

sci. chem. = science chemicals
TB = tennis balls
terra. = terrarium
UF = upholstered furniture
VL = vent location
WP = wall plaster

Comfort Guidelines

Carbon Dioxide: < 600 ppm = preferred
600 - 800 ppm = acceptable
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

Lincoln Park Community School at Thurston St **Indoor Air Results**

50 Thurston Street, Somerville, MA 02145 **Date: 3/1/2006**

Table 1

Location/ Room	Occupants in Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	TVOCs (ppm)	PM2.5 (µg/m3)	Windows Openable	Ventilation Supply	Ventilation Exhaust	Remarks
206	1	74	14	1073	ND	ND	6	Y # open: 0 # total: 2	N	N	laminator, plants.
209A	13	75	15	1173	ND	ND	1	Y # open: 0 # total: 4	N	N	Hallway DO, CD, DEM, items.
209B	2	74	16	1113	ND	ND	5	Y # open: 0 # total: 4	N	N	Hallway DO, CD, DEM, plants.
210A	1	74	15	1208	ND	ND	5	Y # open: 0 # total: 3	N	N	Hallway DO, CD, DEM.
210B	0	73	15	1083	ND	ND	7	Y # open: 2 # total: 4	N	N	Hallway DO, DEM.
211	2	74	16	1279	ND	2	7	Y # open: 0 # total: 1	N	N	cleaners, excessive use of cleaning materials.
212 (reading)	1	74	13	1048	ND	ND	4	Y # open: 1 # total: 1	N	N	Hallway DO, DEM, radiator leaked, now sealed.

ppm = parts per million
µg/m3 = micrograms per cubic meter

AD = air deodorizer
AP = air purifier
aqua. = aquarium
AT = ajar ceiling tile
BD = backdraft
CD = chalk dust
CP = ceiling plaster
CT = ceiling tile
DEM = dry erase materials
design = proximity to door
FC = food container
G = gravity
GW = gypsum wallboard
M = mechanical
MT = missing ceiling tile
NC = non-carpeted
ND = non detect
PC = photocopier
PF = personal fan
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									Supply	Exhaust	
214 (library)	15	74	23	1907	ND	ND	9	Y # open: 0 # total: 10	N	N	DEM, 7 computers.
216	0	72	12	1009	ND	ND	6	Y # open: 2 # total: 10	N	N	Hallway DO,
221	5	73	15	1344	ND	ND	7	Y # open: 0 # total: 6	Y univent (off)	Y closet (off) (BD)	Hallway DO, PF, TB, FC re-use, items.
222	0	75	11	1118	ND	ND	8	Y # open: 0 # total: 4	Y univent (off)	Y closet (off) (BD)	DEM, PF, dust, items.

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